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LETTER TO THE EDITOR

Matrix is a Reasonable Method to Assess Exposures

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W. Caffey Norman III [1995] challenges our methods for assessing exposures to six chlorinated aliphatic hydrocarbons (CAHs) as part of a brain cancer case–control study [Gómez et al., 1994]. Much of his criticism is based on a graphical error in our Figure 1. In that figure, we mistakenly reversed the identification of the lines for methylene chloride and carbon tetrachloride for the last two decades (1971–1980 and 1980+). The corrected figure would show the number of industries with potential methylene chloride uses to be *increasing* in those two periods (top line at the right in the figure), and those for carbon tetrachloride to be *decreasing* (sharply decreasing line). With these corrections, the trends in the figure are consistent with what we reported in the text and with our matrix, and in line with data presented by Mr. Norman. We are grateful to Mr. Norman for identifying this graphical error.

Figure 1 was used only for illustrative purposes, however. It also reflects the most sensitive form of our matrix, so that the industries identified as potential users include those with "low exposure probability," a phenomenon which is not unusual, especially for versatile substances such as these CAHs.

Mr. Norman also cites a 1987 EPA document as evidence that our matrix is flawed with regard to carbon tetrachloride, but his interpretation is incorrect. The EPA document reports industries that may be *sizable* sources of *ambient air emissions*. These are a far cry from our "low-probability" industries, which include many users of the CAHs in amounts well below the thresholds used to identify industry sectors in the EPA document. In this light, the EPA estimate is roughly consistent with our matrix.

We believe that our matrix results in plausible assignments of potential exposure. Moreover, the features of probability, intensity, and decade-of-use specificity offer some improvement over current methods and also permit several innovative forms of epidemiologic analysis. The benefits of these features are discussed in our two original papers [Gómez et al., 1994; Heineman et al., 1994] and documented elsewhere [Dosemeci et al., 1993]. Most importantly, Mr. Norman fails to even mention that nondifferential misclassification tends to bias results toward the null, yet this fact is central to any discussion of the impact on epidemiologic results of potential flaws in our matrix, as discussed by Dr. Heineman [Heineman et al., 1995, 1994] and elsewhere [Wacholder et al., 1991].

All the currently available methods for retrospective exposure assessment in epidemiologic research, including ours, are relatively crude. Our paper identified this issue for "increased critical attention in the literature," and therefore we welcome serious discussion about it. We believe the Halogenated Solvents Industry Alliance, which Mr. Normal represents, is in a unique position to help improve the assessment methods for these CAHs through its knowledge of the life cycles of these CAHs, and its contacts among their producers and users. Specifically, the HSIA could: (1) help develop improved job–exposure matrices; (2) help identify cohorts of workers exposed to these CAHs that meet appropriate criteria for study; (3) sponsor the development of an exposure registry for these compounds, together with other appropriate stakeholders; and (4) help ensure that exposure data *currently* collected for these substances are amenable to future epidemiologic research.

We would gladly collaborate with the HSIA in the implementation of these initiatives.

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